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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/892,884	ABE, TSUTOMU	
	Examiner	Art Unit	
	Kevin Siangchin	2623	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-40* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-40* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *28 June 2001* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Detailed Action

Drawings

Objections

1. The drawings are objected to because of the following.

   a. The handwritten captions depicted in Fig. 1 (e.g. in reference numbers 121 and 125) are illegible and/or are such that they cannot be adequately reproduced. These should be replaced with typed captions to ensure visual clarity and proper reproduction.

   b. The handwritten captions depicted in Fig. 4 (e.g. in step S17) are illegible and/or are such that they cannot be adequately reproduced. These should be replaced with typed captions to ensure visual clarity and proper reproduction.

   c. The handwritten captions depicted in Fig. 11 are illegible and/or are such that they cannot be adequately reproduced. These should be replaced with typed captions to ensure visual clarity and proper reproduction.

   d. The handwritten captions depicted in Fig. 13 (e.g. in reference numbers 1301-1302) are illegible and/or are such that they cannot be adequately reproduced. These should be replaced with typed captions to ensure visual clarity and proper reproduction.

   e. The handwritten captions depicted in Fig. 20 (e.g. in reference numbers 1301-1302) are illegible and/or are such that they cannot be adequately reproduced. These should be replaced with typed captions to ensure visual clarity and proper reproduction.

   f. The handwritten captions depicted in Fig. 26 (e.g. in reference numbers 1301-1302) are illegible and/or are such that they cannot be adequately reproduced. These should be replaced with typed captions to ensure visual clarity and proper reproduction.

   g. The pattern depicted Figure 10 does not correlate to the corresponding discussion found in the last paragraph of page 23 of the Applicant's disclosure; or, its intended meaning cannot be

discerned from its deficient description in the aforementioned part of the Applicant's disclosure. For instance, Fig. 10 appears to depict the newly coded pattern corresponding to an arbitrary section (notice the dimensions of the section are different) of the patterns depicted in Figs. 6, 8 and 9. It cannot be determined from the Applicant's disclosure what section of the original pattern(s) this corresponds to or how it was obtained in the first place. See the discussion below relating to the Applicant's specification.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

Objections

2. *Title of the Invention.* The title of the invention is not descriptive. A new title is required that is *clearly indicative* of the invention to which the claims are directed.

3. The disclosure is objected to because of the following informalities:

a. On page 21, paragraph 2 (last sentence) of the Applicant's disclosure, the reference number 305 is used to indicate a *filter* and an *image pickup apparatus*. The reference numbers attributed to these items should be changed to correspond to Fig. 3.

b. On page 22, last paragraph to page 23, first paragraph, the Applicant refers to steps 1001-1007 of Fig. 4. These reference numbers are not shown in Fig. 4. These reference numbers should be changed to reflect what is shown in Fig. 4 or the reference numbers of Fig. 4 should be changed to correspond to this part of the disclosure.

c. On page 41, paragraph 4 of the Applicant's disclosure, the Applicant refers to an OHP (overhead projector) 2805. Fig. 28 shows OHP 2804. The specification should be corrected to indicate this.

d. The pattern depicted Figure 10 does not correlate to the corresponding discussion found in the last paragraph of page 23 of the Applicant's disclosure; or, its intended meaning cannot be discerned from its deficient description in the aforementioned part of the Applicant's disclosure. For instance, Fig. 10 appears to depict the newly coded pattern corresponding to an arbitrary section (notice the dimensions of the section are different) of the patterns depicted in Figs. 6, 8 and 9. It cannot be determined from the Applicant's disclosure what section of the original pattern(s) this corresponds to or how it was obtained in the first place. If Fig. 10 is correct, then the Applicant should provide an adequate explanation of how to arrive at the pattern depicted in Fig. 10 (without introducing new matter) and what section of the patterns depicted in Figs. 6, 8, and 9 Fig. 10 corresponds to.

Appropriate correction is required.

4. According to C.F.R § 1.73, the Summary of the Invention should be a "*brief summary* of the invention indicating its nature and substance, which may include a statement of the object of the invention, should precede the detailed description". The Summary of the Invention supplied by the Applicant can hardly be considered *brief.* The applicant has chosen to merely repeat the Claims, instead of providing a summation of the invention and its advantages. As such, the submitted Summary is unnecessarily repetitive, redundantly repeating the proposed inventive features as in the claims. The applicant is advised to succinctly summarize the invention, its various embodiments and the objects of the invention.

Claims

Objections

5. Claims 6 and 14 are objected to because of the following informalities. On lines 2-4 of claim 6, the Applicant refers to "light of an invisible region". This terminology can be misleading. For example, light of an invisible region could be interpreted as meaning light emanating from an occluded region of the observed scene. Other misinterpretation are possible. It seems from the Applicant's disclosure that claim 6 was meant to refer to light

of an invisible region of the electromagnetic spectrum. This should be somehow indicated in claim 6. Claim 14 should be changed similarly. Appropriate correction is required.

Rejections Under 35 U.S.C. § 112(2)

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 7, 15, 22, 27, 32 and 37-40 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

8. *The following is in regard to Claims 17, 27, and 37-40.* Claims 17, 27, and 37-40 recite the limitation "intensity image acquired in advance ". There is insufficient antecedent basis for this limitation in the claims.

9. *The following is in regard to Claims 7 and 15.* These claims recite the limitation "creating second range information by *bringing the area into correspondence* with intensity information obtained by the first and second image pickup parts". It is not clear, even in light of the specification, what is meant by *bringing the area into correspondence.* While this could mean aligning the area with intensity information obtained by the first and second image pickup parts, such alignment is not disclosed. However, the Applicant does derive correspondences between the "intensity information obtained by the first and second image pickup parts" (last paragraph on page 24 of the Applicant's disclosure). Therefore, for the remainder of this document it will be assumed that, in claims 7 and 15, "creating second range information by *bringing the area into correspondence* with intensity information obtained by the first and second image pickup parts" means "creating second range information by *deriving a correspondence between* intensity information obtained by the first and second image pickup parts".

10. *The following is in regard to Claim 22 and 32.* In these claims, it is unclear as to what transforming the extracted character data to character data replaceable as a code value. The Applicant's disclosure does not resolve this ambiguity. Transforming the extracted character data to character data replaceable as a code value will be treated, in this document, as transforming extracted handwritten characters or text (e.g. by handwriting or optical character recognition) to standard character codes such as ASCII, or the like.

Rejections Under 35 U.S.C. § 102(b)

11. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

12. Claims 1, 8, 9, and 16 are rejected under 35 U.S.C. 102(b) as being anticipated by Kang et al. ("A Multibaseline Stereo System with Active Illumination and Real-Time Image Acquisition", *IEEE*, 1995).

13. *The following is in regard to Claim 9.* Kang et al. disclose an depth reconstruction system utilizing multiple cameras and the projection of temporally coded structured light (Kang et al. Abstract). The method includes the following:

(9.a.) Four cameras (i.e. a first, second, third, and fourth image pickup part) picks up stereo intensity images of a scene illuminated by an active illumination (i.e. a "projection pattern" of light having sinusoidally varying intensity). The cameras have disjoint optical axes that are separated by some fixed *baseline* distance. See paragraph 1 of Section 2 on page 88 of Kang et al.

(9.b.) Recovering depth (range) data from analysis of the stereo images (i.e. "creating first range information based on the pattern picked up by the second image pickup part"). See the Abstract of Kang et al.

(9.c.) Performing a geometric transformation (e.g. application of the rectified homographies K_1 , K_2 , and K_3 – Kang et al. Fig. 5 and section 4.3) for the intensity image produced by the cameras based on the range information. Note that the rectified homographies, being 2D affine transformations (Kang et al. page 90, right column, paragraph 4), are geometric transformations.

It has thus been shown that the depth recovery method of Kang et al. sufficiently conforms to the image processing method proposed by the Applicant in claim 9. Therefore, the teachings of Kang et al. anticipate the method of claim 9.

14. *The following is in regard to Claim 16.* As shown above, Kang et al. disclose a depth recovery method that adequately satisfies the limitations of claim 9. The cameras used in the method of Kang et al. are have non-parallel optical axes. See, for example, Kang et al. Fig. 3 and the description of the Kang et al.'s *verged camera configuration* in Section 2.1. Therefore, the cameras (including the second camera or image pickup part) capture the measurement target at different angles. Depth (range) information, according to the method of Kang et al., is derived from the images of the scene having active illumination projected onto it. Taking this into account, the method of Kang et al. is such that the cameras (the image pickup parts), including the second camera, comprise plural image pickup parts that pick up the measurement target at different angles. The method also involves creating range information based on projection patterns respectively picked up by the plural image pickup parts of the cameras, including the second camera. This method is, therefore, in accordance with that which is proposed in claim 16.

15. *The following is in regard to Claim 1.* Claim 1 recites substantially the same limitations as claim 9 (the claimed apparatus merely being physical manifestation of the method proposed in claim 9). Therefore, with regard to claim 1, remarks analogous to those presented above relating to claim 9 are applicable.

16. *The following is in regard to Claim 8.* As shown above, Kang et al. adequately address the limitations of claim 1. Claim 8 recites substantially the same limitations as claim 16 (the claimed apparatus merely being physical manifestation of the method proposed in claim 16). Therefore, with regard to claim 8, remarks analogous to those presented above relating to claim 16 are applicable.

Rejections Under 35 U.S.C. § 103(a)

17. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

18. Claims 2-4, 7, 10-12 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al. in view of Batlle et al. ("Recent Progress in Coded Structured Light as a Technique to Solve the Correspondence Problem: A Survey", *Pattern Recognition*, 1998).

19. *The following is in regard to Claim 10.* As shown above, Kang et al. disclose a depth recovery method that adequately satisfies the limitations of claim 9. Kang et al., however, does not expressly show or suggest that the range information be derived by:

(10.a.) For an area where the amount of change of the pattern picked up by the first image pickup part with respect to the projection pattern is equal to or greater than a predetermined value.

(10.b.) Assigning new code corresponding to the pattern picked up by the first image pickup part.

(10.c.) Creating the first range information from the pattern picked up by the second image pickup part based on the new code.

Despite this, these aspects follow implicitly from Kang et al.'s usage of structured light, as shown below.

20. Batlle et al. present a survey of various coded structured light methods. With regard to claim 10, reference will be made here to the technique suggested by Posdamer and Altshuler and discussed in Section 6.1 (page 969) of Batlle et al. and Sato and Inokuchi's later extension of that methodology (Batlle et al. page 970). The technique includes the projection of a temporally varying binary pattern onto the scene (Batlle et al. Fig. 3). In this way, sections of the patterns are temporally encoded (Batlle et al. Fig. 4). Sato et al. propose the usage of a *dynamic threshold* indicative of the difference between the observed pattern intensity and the reference (projected) pattern intensity (Batlle et al. page 970, last paragraph of left column). Taking this into account, Batlle et al. thus teaches a coded structured light method that includes:

(10.a'.) For an area where the amount of change of the pattern picked up by the an image pickup part with respect to the projection pattern is equal to or greater than a predetermined value (Batlle et al. page 970, last paragraph of left column).

(10.b'.) Assigning new code corresponding to the pattern picked up by the image pickup part (e.g. by the temporal binary codification discussed above).

(10.c'.) Creating the first range information from the pattern picked up by the image pickup part

based on the new code (Batlle et al. Abstract).

21. The teachings of Batlle et al. and Kang et al. are combinable because they are analogous art. Specifically, Kang et al. describe a method that uses structured light principles in a passive stereo system, yet omit the details of the structured light employed. Batlle et al., on the other hand, discuss, in detail, various structured light methods, including one that involves steps (10.a′.)-(10.c′.) above. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed invention, to utilize the coded structured light methodology discussed above and by Batlle et al. to codify the projected pattern used in Kang et al.'s reconstruction method. The motivation to do so would have been to distinguish pixels or groups of pixels in the captured images by determining which beam column (or other coded pattern segment) has been projected onto the scene (Batlle et al. Section 6.1, paragraph 3 (last sentence)). This increases the local discriminability at each pixel or pixel group, thereby, allowing the acquisition of accurate and dense depth data (Kang et al. page 88, right column, sentence 1). Using such a coded structured light scheme in the depth recovery method of Kang et al. yields a method where range data is derived by

(10.a.) For an area where the amount of change of the pattern picked up by the four cameras (including the first camera) with respect to the projection pattern is equal to or greater than a predetermined value.

(10.b.) Assigning new code corresponding to the pattern picked up by the cameras (including the first camera).

(10.c.) Creating the first range information from the pattern picked up by the cameras (including the second camera) based on the new code.

Such a method is in accordance with the image processing method proposed by the Applicant in claim 10.

22. *The following is in regard to Claim 11.* As shown above, Kang et al. disclose a depth recovery method that adequately satisfies the limitations of claim 9. The method of Kang et al., being a stereo-vision method, further includes making comparison between captured frame data images (Kang et al. Section 4.1). By incorporating the coded structured light of Batlle et al.'s teachings as discussed above, these captured frame data images would be acquired in a time-series (recall the temporal encoding of the projected pattern discussed above). Therefore, the method obtained by combining the teachings Kang et al. and Batlle et al., in the manner discussed above, would

include: making comparison between frame data images picked up in a time-series[1]. Furthermore, as indicated by Batlle et al. (e.g. Batlle et al. page 978, right column, lines 1-3), the presence of noise obfuscates the derivation of the correspondence between the images captured from the cameras. Therefore, in order to facilitate the derivation of a proper correspondence and, thereby, eliminate potential depth discontinuities, it would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed invention, to eliminate noise data from the frame data image based on a result of the comparison between the frame data images. Therefore, in this manner, the method obtained by combining the teachings Kang et al. and Batlle et al., in the manner discussed above, conforms to the method proposed by the Applicant in claim 11.

23. *The following is in regard to Claim 12.* As shown above, Kang et al. disclose a depth recovery method that adequately satisfies the limitations of claim 9. As discussed above, the teachings of Kang et al. and Batlle et al. can be combined[1] to obtain a method, wherein a comparison is made between frame data images picked up in a time-series. Furthermore, Kang et al. teach a process of *rectification* (Kang et al. page 89, Section 4, paragraphs 1-2) that involves modifying a position of the frame data image based on a result of the comparison between the frame data images. Therefore, in this manner, the method obtained by combining the teachings Kang et al. and Batlle et al., in the manner discussed above, conforms to the method proposed by the Applicant in claim 12.

24. *The following is in regard to Claim 15.* As shown above, Kang et al. disclose a depth recovery method that adequately satisfies the limitations of claim 9. In the method of Kang et al., as in most method utilizing stereo vision, correspondences are derived between captured stereo images, in processes known as *stereo matching.* See, for example, Kang et al. Abstract, Introduction (paragraph 1), and paragraph 1 of Section 4.1, in conjunction with Figs. 3-4. Note also that such correspondences are also embodied in the various homographies derived according to the method of Kang et al. (paragraph 3 of Kang et al. Section 4). These homographies provide a bijective map between points, and hence *all* areas, of adjacent images. These homographies are derived between all adjacent cameras (including the first and second). Kang et al., however, do not show determining an amount of change of the pattern captured by a camera with respect to the projection pattern and determining whether or not it is less than a predetermined value.

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1 The motivation to incorporate this coded structured light method into the method of Kang et al. was discussed above with regard to claim 10.

25. As discussed above (see the discussion above with respect to steps (10.a)-(10.c)), Batlle et al. teach a coded structured light method that includes: Evaluating whether an area is such that the amount of change of the pattern picked up by the an image pickup part with respect to the projection pattern is equal to or greater than a predetermined value (Batlle et al. page 970, last paragraph of left column). Consequently, the determination of whether not the amount of change is less than the predetermined value is made implicitly for areas deemed not to satisfy this criterion.

26. The teachings of Batlle et al. and Kang et al. are combinable because they are analogous art. Specifically, Kang et al. describe a method that uses structured light principles in a passive stereo system, yet omit the details of the structured light employed. Batlle et al., on the other hand, discuss, in detail, various structured light methods. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed invention, to evaluate whether or not an area is such that the amount of change of the pattern picked up by the an image pickup part with respect to the projection pattern is less than a predetermined value. As indicated by Batlle et al. (Batlle et al. page 970, last paragraph of left column), this has the advantage of distinguishing between high contrast transitions that are part of the observed scene itself, as opposed to high contrast transitions that occur as a result of the projected pattern. Combining the teachings of Batlle et al. and Kang et al. yields a method of depth recovery that includes:

(15.a.) Evaluating whether or not areas of a captured images is such that the amount of change of the pattern picked up by the an image pickup part with respect to the projection pattern is less than a predetermined value.

(15.b.) Deriving correspondences between *all* adjacent (including those obtained from the first and the second cameras) stereo images (including those obtained from the first and the second cameras)

Since, in such a method, correspondences are derived for all pixels in the captured images (including those having an amount of change less than the predetermined value), the method obtained as such conforms sufficiently to that of claim 15.

27. *The following is in regard to Claims 2-4 and 7.* As shown above, Kang et al. adequately address the limitations of claim 1. Claims 2-4 recites substantially the same limitations as claims 10-12 and 15, respectively.

(The claimed apparatuses merely implement the corresponding methods of claims 10-12 and 15). Therefore, with regard to claims 2-4 and 7, remarks analogous to those presented above relating to claims 10-12 and 15 are respectively applicable.

28. Claims 6 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., in view of Mack et al. (U.S. Patent 6,377,700).

29. *The following is in regard to Claim 14.* As shown above, Kang et al. disclose a depth recovery method that adequately satisfies the limitations of claim 9. Though Kang et al. show the capture of the intensity image of the scene having an active illumination projected onto it (i.e. the pattern projection image and intensity image picked up in parallel – see above), Kang et al. does not expressly show or suggest casting a pattern light formed by invisible-region light such as infrared or ultraviolet light.

30. As noted above, the active illumination acts a structured light mechanism that facilitates the local discrimination of corresponding pixels among the captured images. Mack et al. discloses a 3D reconstruction method that uses structured light projected onto the scene or object under observation (e.g. Mack et al. Abstract and Field of Invention). Mack et al. suggests the usage of infrared light patterns as the structured light projected onto the scene. See, for example, Mack et al. column 5, lines 15-21 and lines 49-58.

31. The teachings of Mack et al. and Kang et al. are combinable because they are analogous art. In particular, both Kang et al. and Mack et al. disclose a stereoscopic techniques of stereoscopic depth recovery or 3D reconstruction that employ structured lighting. Therefore, given the teachings of Mack et al., it would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed invention, to use an active illumination, or structured lighting, that is formed of patterns of infrared illumination in the depth recovery method of Kang et al. The motivation for doing so would have been to project patterns onto the scene that are invisible and less offensive to the human eye. The method thus obtained would conform to the image processing method proposed by the Applicant in claim 14.

32. *The following is in regard to Claim 6.* As shown above, Kang et al. adequately address the limitations of claim 1. Despite its awkward wording (see discussion above relating to the objection of this claim), claim 6 recites

substantially the same limitations as claim 14. (The claimed apparatus merely implements the corresponding method of claims 14). Therefore, with regard to claim 6, remarks analogous to those presented above relating to claim 14 are applicable.

33. Claims 5 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., in view of Perona et al. (U.S. Patent 6,377,700).

34. *The following is in regard to Claim 13.* As shown above, Kang et al. adequately address the limitations of claim 1. Kang et al., however, do not expressly show or suggest:

(13.a.) Storing in a storage part an initial image of frame data picked up in a time-series.

(13.b.) Making comparison between frame data images picked up in a time-series.

(13.c.) Extracting only differential data as storage data based on a result of the comparison between the initial frame data and frame data subsequently picked up.

35. Perona et al. disclose a method and apparatus for tracking handwriting by detecting the movement of a writing implement relative to a writing surface relative to a writing surface. Perona et al. suggest a stereo-vision approach to determining the 3D position (particularly depth information) of the writing implement during the tracking (Perona et al. column 7, lines 66-67 to column 8, lines 1-6 and 23-28). To capture the movements of the writing, Perona et al. capture multiple frames of images (stereo pairs, if stereo is used) and extracts the difference between the adjacent frames. See Perona et al. Fig. 4, steps 400-402 and column 5, lines 30-35. This clearly addresses steps (13.a.)-(13.c.)

36. The teachings of Perona et al. and Kang et al. are combinable because they are analogous art. Perona et al. suggest the usage of stereo-vision techniques to acquire 3D information of the writing surface, while Kang et al. acquiring 3D information of an observed scene via stereo-vision techniques. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed invention, to extend the stereo-vision depth recovery methodology of Kang et al. to the handwriting tracking method of Perona et al. The motivation to do so would have been to exploit the accuracy of Kang et al. method of depth recovery (Kang et al. Abstract) to detect and track the 3D dimensional position of a writing implement, according to Perona et al.'s method. Combining the

teachings of Kang et al. and Perona et al., in this manner, produces a method that sufficiently conforms to that of claim 13.

37. *The following is in regard to Claim 5.* Claim 5 recites substantially the same limitations as claim 13. (The claimed apparatus merely implements the corresponding method of claims 13). Therefore, with regard to claim 5, remarks analogous to those presented above relating to claim 13 are applicable.

38. Claims 27-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Saund et al. (U.S. Patent 5,764,383)[2], in view of Perona et al.

39. *The following is in regard to Claim 27.* Saund et al. disclose a platenless book scanning system and method that uses structured light to obtain a 3D dimensional representation of the observed book (e.g. Saund et al. (925) Abstract). The method of Saund et al. includes the following:

(27.a.) Projecting light to an image holding medium (e.g. platform 8 of Saund et al. (383) or Saund et al. (925) Fig. 1) to form an image thereon. See, for example, Saund et al. (925) column 6, lines 19-35.

(27.b.) Capturing the image (e.g. image I_1 – Saund et al. (925) column 7, lines 49-50) projected on the image holding medium. See, for example, Saund et al. (925) column 6, lines 6-18.

(27.c.) Acquiring an intensity image (e.g. image I_2 – Saund et al. (925) column 7, lines 53-54) based on the image picked up in the image pickup step. See, for example, Saund et al. (925) column 6, lines 6-18.

(27.d.) Acquiring range information from the picked-up image (e.g. Saund et al. (925) column 6 (lines 19-21), column 7 (lines 16-21) and Figs. 8-9).

(27.e.) Performing geometric transformation (e.g. skew correction via the *page shape transform*) for the intensity image based on the range information acquired in the range information

2 Notice that, in column 8, lines 31-37 of U.S. Patent 5,764,383, Saund et al. incorporate by reference U.S. Patent Application 09/657,711 (now U.S. Patent 5,760,925 issued to the same inventors and assignee). In accordance with MPEP § 2163.07(b), all material disclosed therein will be treated as part of U.S. Patent 5,764,383. Consequently, when referring to Saund et al. in this document, reference will actually be made to both U.S. Patent 5,764,383 and U.S. Patent 5,760,925. For the sake of clarity, any specific references to either U.S. Patent 5,764,383 or U.S. Patent 5,760,925 will be denoted as Saund et al. (383) or Saund et al. (925), respectively.

acquisition step. Refer to Saund et al. (383) Fig. 7 and column 7, lines 63-67 to column 8, lines 1-8.

Though Saund et al. suggest the subtraction – i.e. the extraction of the difference – of intensity images (e.g. image data 32 (I_2) and page shape data (I_1) – Saund et al. (925) column 15, lines 24-32), Saund et al. does not expressly show or suggest (27.f.) extracting difference between the *geometric-transformed* intensity image and the intensity image acquired *in advance*.

40. Perona et al. disclose a method and apparatus for tracking handwriting by detecting the movement of a writing implement relative to a writing surface relative to a writing surface. Perona et al. suggest a stereo-vision approach to determining the 3D position (particularly depth information) of the writing implement during the tracking (Perona et al. column 7, lines 66-67 to column 8, lines 1-6 and 23-28). To capture the movements of the writing, Perona et al. capture multiple frames of images (stereo pairs, if stereo is used) and extracts the difference between the adjacent frames. See Perona et al. Fig. 4, steps 400-402 and column 5, lines 30-35.

41. The teachings of Perona et al. and Saund et al. are combinable because they are analogous art. First note the structural similarities of the systems of Perona et al. and Saund et al., depicted respectively in Perona et al. and Saund et al. Fig. 1. Secondly, Perona et al. suggest the usage of stereo-vision techniques to acquire 3D information of the writing surface. As is well-known, structured light methods, such as that of Saund et al. are often interchangeable with stereo-vision methods as a means to obtain 3D information of an observed scene. Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed invention, to employ the structured light method of Saund et al. (steps (27.a.)-(27.e.) above) to obtain a skew-corrected 3D representation of a dynamic writing surface[3] in a writing tracking method, such as that of Perona et al. One motivation to extend the scanning method of Saund et al. so as to accommodate the tracking of handwriting would have been to construct a "digital desktop". Perona et al. suggests this in column 2, lines 36-43 and lines 49-53. Incorporating the teachings of Perona et al. into the method of Saund et al., yields a method including steps (27.a)-(27.e) above, as well as (27.f): extracting difference between the geometric-transformed intensity image[4] (e.g. F_{10} of

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3 The writing surface (i.e. the book) being scanned in Saund et al.'s method is static, in the sense that the text is fixed, as opposed to being a dynamic writing surface having handwriting added to it.

4 Presumably each frame, in such a combined method, would undergo the skew correction proposed by Saund et al., if necessary.

Perona et al. Fig. 4) and the intensity image acquired in advance (e.g. F_1 of Perona et al. Fig. 4). That is, the method thus obtained conforms sufficiently to the image processing method proposed by the Applicant in claim 27.

42. *The following is in regard to Claim 28.* As shown above, the teachings of Saund et al. and Perona et al., when combined in the manner discussed above, adequately address all subject matter set forth by the Applicant in claim 27. Perona et al. suggest that the image holding medium, or writing surface, be a whiteboard or manuscript sheet (Perona et al. column 3, lines 52-57). Saund et al. also suggest that the subject of the scanning may be a manuscript sheet (e.g. the scanned pages of book 10 depicted in Saund et al. (925) Fig. 1). In this way, the method obtained by combining the teachings of Saund et al. and Perona et al. in the manner discussed above, conforms sufficiently to the image processing method of claim 28.

43. *The following is in regard to Claim 29.* As shown above, the teachings of Saund et al. and Perona et al., when combined in the manner discussed above, adequately address all subject matter set forth by the Applicant in claim 27. As discussed above with regard to claim 27, the intensity image acquired in advance as a processing target in the image extracting step is a preceding frame image inputted precedent to the geometric transformation step. In fact, this limitation follows directly from the language of claim 27 ("...geometric-transformed intensity image and the intensity image acquired in advance"). In this way, the method obtained by combining the teachings of Saund et al. and Perona et al. in the manner discussed above, conforms sufficiently to the image processing method of claim 29.

44. *The following is in regard to Claim 30.* As shown above, the teachings of Saund et al. and Perona et al., when combined in the manner discussed above, adequately address all subject matter set forth by the Applicant in claim 27. Clearly, if one desires to process an image, or any data for that matter, acquired at some prior time, then the associated data must be stored in some means of storage, at the time of its acquisition (i.e. *in advance* of the processing). Therefore, the feature proposed in claim 30 would be inherent to method obtained by combining the teachings of Saund et al. and Perona et al. in the manner discussed above.

45. Claims 17-24, 26-27, 31-34, and 36-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Saund et al. (U.S. Patent 5,764,383), in view of Stolfo (U.S. Patent 5,668,897).

46. *The following is in regard to Claims 27 and 31.* Saund et al. disclose a platenless book scanning system and method that uses structured light to obtain a 3D dimensional representation of the observed book (e.g. Saund et al. (925) Abstract). The method of Saund et al. includes the following:

(27.a.) Projecting light to an image holding medium (e.g. platform 8 of Saund et al. (383) or Saund et al. (925) Fig. 1) to form an image thereon. See, for example, Saund et al. (925) column 6, lines 19-35.

(27.b.) Capturing the image (e.g. image I_1 – Saund et al. (925) column 7, lines 49-50) projected on the image holding medium. See, for example, Saund et al. (925) column 6, lines 6-18.

(27.c.) Acquiring an intensity image (e.g. image I_2 – Saund et al. (925) column 7, lines 53-54) based on the image picked up in the image pickup step. See, for example, Saund et al. (925) column 6, lines 6-18.

(27.d.) Acquiring range information from the picked-up image (e.g. Saund et al. (925) column 6 (lines 19-21), column 7 (lines 16-21) and Figs. 8-9).

(27.e.) Performing geometric transformation (e.g. skew correction via the *page shape transform*) for the intensity image based on the range information acquired in the range information acquisition step. Refer to Saund et al. (383) Fig. 7 and column 7, lines 63-67 to column 8, lines 1-8.

Saund et al., however, do not expressly show or suggest:

(31.a.) Storing plural pieces of document format data in a document database.

(31.b.) Performing matching between a geometric-transformed intensity image and the pieces of document format data stored in the document database.

(31.c.) Extracting a difference between the geometric-transformed intensity image and the pieces of document format data stored in the document database[5].

5 Note that step (31.c) essentially consists of (27.f) extracting difference between the geometric-transformed intensity image and the intensity image acquired in advance, where the latter intensity image would correspond to the document format data.

47. Many so-called "form drop-out" techniques perform these steps. For example, Stolfo discloses a methodology for extracting or separating handwritten text from standardized documents, such as various types of checks (Stolfo, Summary of Invention, paragraph 1 and column 21, lines 5-11). According to this methodology:

(31.a′.) Plural pieces of document format data[6] are stored in a document database. This is suggested in Stolfo column 7, lines 23-25.

(31.b′.) A scanned (intensity) image is matched to the pieces of document format data stored in the document database (Stolfo column 7, lines 8-22).

(31.c′.) A subtraction (i.e. extraction of the difference) is performed between the intensity image and the pieces of document format data stored in the document database (Stolfo column 7, lines 19-22).

48. The teachings of Saund et al. and Stolfo are combinable because they are analogous art. Specifically, Saund et al. demonstrate a method for scanning a document that eliminates skew. Stolfo, on the other hand, discuss a method of handwriting extraction that calls for the document scanning. In particular, Stolfo's method calls for scanned documents to be, among other things, skew-corrected (e.g. Stolfo column 14, lines 62-66 and column 3, lines 29-43). Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed invention, to apply the platenless book scanning methodology of Saund et al. to a handwriting extraction method such as that of Stolfo, thereby generating a geometrically-transformed intensity image for which to process. The motivation for doing so would have been to provide handwriting extraction from standardized documents that have been skew-corrected. Combining these methods in this manner yields a handwriting extraction method having steps (27.a)-(27.e) above as well as the steps of:

(31.a.) Storing plural pieces of document format data in a document database.

(31.b.) Performing matching between a geometric-transformed intensity image and the pieces of document format data stored in the document database.

(31.c.) Extracting a difference between the geometric-transformed intensity image and the pieces of document format data stored in the document database.

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6 The (somewhat misleading) term *document format data* is taken in this case to mean a standard document image or template. This is consistent with the Applicant's usage of the term.

The method thus obtained adequately satisfies the limitations of claims 27 and 31.

49. *The following is in regard to Claim 32.* As shown above, the teachings of Saund et al. and Stolfo can be combined so as to yield a method that sufficiently conforms to the image processing method of claim 27. Stolfo suggests the usage of handwriting recognition or optical character recognition on the handwriting from the standardized documents (e.g. Stolfo column 4, lines 58-63). This sufficiently addresses the limitations of claim 32. Therefore, the method obtained by combining the teachings of Stolfo and Saund et al., in the manner discussed above, conforms substantially to the image processing method claim 32.

50. *The following is in regard to Claims 33-34.* As shown above, the teachings of Saund et al. and Stolfo can be combined so as to yield a method that sufficiently conforms to the image processing method of claim 27. According to Stolfo (Stolfo column 26, lines 66-67 to column 27, lines 1-6), the extracted handwriting, specifically the check signature, can be authenticated against a database of signatures (i.e. a "handwriting history data of registered users in a authentication information database"). Clearly, performing matching between the input image and the handwriting history data stored in the authentication information database would be inherent to such an authentication process. Furthermore, given the discussion above, it can be reasonably assumed that the geometric-transformed intensity image serves as input. Therefore, the method obtained by combining the teachings of Stolfo and Saund et al., in the manner discussed above, conforms substantially to the image processing method claim 33. In addition, since the authentication taught by Stolfo is of the signature extracted from the scanned document, the method thus obtained also adequately satisfies the limitations of claim 34.

51. *The following is in regard to Claim 36.* As shown above, the teachings of Saund et al. and Stolfo can be combined so as to yield a method that sufficiently conforms to the image processing method of claim 27. It should be (overwhelmingly) apparent that the range information would be stored after being derived. Furthermore, it should be apparent from Saund et al. (e.g. Saund et al. (383) Fig. 1) that the camera is in a fixed position relative to the document, or more particularly, the document holder[7]. In this way, the method, obtained by combining the teachings of Stolfo and Saund et al. as discussed above, conforms substantially to the image processing method claim 36.

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7 If it were not the various transforms (in particular the perspective transform) derived according to Saund et al. would be invalid, or the entire system would have to be constantly recalibrated. One of ordinary skill in the art would easily recognize this.

52. *The following is in regard to Claim 17-24 and 26.* As shown above, teachings of Saund et al. and Stolfo, when combined in the manner discussed above, adequately address the limitations of claim 17. Claims 17-24 and 26 recite substantially the same limitations as claims 27-24 and 26, respectively. (The claimed apparatuses merely implement the corresponding methods of claims 27-24 and 26). Therefore, with regard to claims 17-24 and 26, remarks analogous to those presented above relating to claims 27-24 and 26 are respectively applicable.

53. *The following is in regard to Claim 37.* Claim 27 recites substantially the same limitations as claim 27. (The claimed storage medium contains a program that merely implements the corresponding methods of claims 27). Therefore, with regard to claim 37, remarks analogous to those presented above relating to claim 27 are applicable.

54. *The following is in regard to Claims 38-40.* Note that since capturing an image of a scene (the image holding medium) having projected light cast upon it is essentially the same as picking up the projected light, claims 38-40 do not introduce anything substantively different from what is claimed in claims 17, 27, and 37, respectively. Therefore, with regard to claims 38-40, remarks analogous to those presented above relating to claims 17, 27, and 37 are respectively applicable.

55. Claims 25 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Saund et al., in view of Stolfo, in further view of Wellner (U.S. Patent 5,511,148).

56. *The following is in regard to Claim 35.* As shown above, the teachings of Saund et al. and Stolfo can be combined to satisfies the limitations of claim 27. However, neither Saund et al. nor Stolfo expressly show or suggest displaying an image produced as a result of performing geometric transformation for the intensity image based on the range information.

57. Wellner disclose an "interactive digital desktop", that is, a system for generating new documents from originals containing text and/or images employing e.g. a camera-projector system focused on a work surface (Wellner Abstract). In Wellner's system (depicted in Wellner Fig. 1) a video projector 8 is mounted adjacent the camera 6 and projects onto the surface 2 a display 21 which is generally coincident with the field of view of the camera 6, and which, in the example shown, includes an image of a newly created document 20. This projected

document image is skew-corrected (Wellner column 10, lines 61-62). In this way, Wellner teaches displaying an image produced as a result of performing geometric transformation for the intensity image.

58. The teachings of Wellner are combinable with those of Saund et al. and Stolfo because they are analogous art. Specifically, Wellner's teachings are related to both platenless scanning (see Wellner Fig. 1) and text extraction and recognition (Wellner column 9, lines 60-63). Therefore, it would have been obvious to one of ordinary skill in the art, at the time of the applicant's claimed invention, to incorporate the projection or display functionality of Wellner's digital desktop into the method obtained by combining the teachings of Stolfo and Saund et al., as discussed above, wherein skew-correction is performed according to the method proposed by Saund et al. The motivation for doing so would have been to provide the user with visual feedback relating to the alignment of the document. Incorporating this display functionality in this way yields a method, in accordance with claim 27, further configured to display an image produced as a result of performing geometric transformation for the intensity image based on the range information. A method thus obtained sufficiently conforms to the image processing method proposed by the Applicant in claim 35.

59. *The following is in regard to Claim 25.* Claim 25 recites substantially the same limitations as claim 38. (The claimed apparatus merely implements the method of claim 35). Therefore, with regard to claim 25, remarks analogous to those presented above relating to claim 35 are applicable.

Citation of Relevant Prior Art

60. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure: The following are systems and/or methods that combine or otherwise utilize both passive (e.g. stereo-pairs) and active (e.g. structured light) stereo vision techniques:

[1] *U.S. Patent 6,028,672.* Geng. Publication Date: Feb. 2000

[2] *U.S. Patent 6,750,873.* Bernardini et al. Publication Date: Jul. 2004

[3] *Passive and Active Stereo Vision for Smooth Surface Detection of Deformed Plates.* IEEE

1995, Chen, et al.

[5] *U.S. Patent 6,674,893.* Abe et al. Publication Date: Jan. 2004

[6] *U.S. Patent 6,356,298.* Abe et al. Publication Date: Mar. 2002

[7] *U.S. Patent 4,687,326.* Corby, Jr. Publication Date: Aug. 1987

[8] *Spacetime Stereo: Shape Recovery for Dynamic Scenes.* IEEE, 2003. Zhang et al.

The following references deal with the extraction and recognition of text via 3D imaging of a document or scene:

[9] *U.S. Patent 5,581,637.* Cass et al. Publication Date: Dec. 1996

[10] *U.S. Patent 6,563,948.* Tan et al. Publication Date: May. 2003

[11] *Passive and Active Stereo Vision for Smooth Surface Detection of Deformed Plates.* IEEE 1995, Chen, et al.

The following reference detects and removes regions of an image corresponding to fingers and the like:

[12] *U.S. Patent 6,256,411.* Iida. Publication Date: July 2001

The following reference deal with extraction of text or handwriting from images, and more generally, the process known as "form drop-out":

[13] *U.S. Patent 6,023,534.* Handley. Publication Date: Feb. 2000

[14] *U.S. Patent 6,701,013.* Charpentier. Publication Date: Mar. 2004

[15] *U.S. Patent 6,320,983.* Matsuno et al. Publication Date: Nov. 20

[16] *U.S. Patent 5,201,011.* Bloomberg et al. Publication Date: Apr. 1993

[17] *A System to Read Names and Addresses on Tax Forms.* IEEE, 1996. Sargur et al.

[18] *User-Defined Template for Identifying Document Type and Extracting Information from Documents.* IEEE, 1999Kochi et al.

[19] *A Generic System to Extract and Clean Handwritten Data From Business Forms.* Proceedings of the Workshop on Frontiers in Handwriting Recognition, September 2000. Ye et al.

The following references are related to "interactive digital desktops" and related collaborative environment systems:

[20] *Interacting with Paper on the Digital Desk.* ACM, 1993. Wellner.

[21] *Interactive Design of Seamless Collaboration Media.* ACM, 1994. Ishii et al.

[22] *Something From Nothing: Augmenting a Paper-based Work Practice via Multimodal Interaction.* ACM, 2000. McGee et al.

[23] *VideoDraw: A Video Interface for Collaborative Drawing.* ACM, 1991. Tang et al.

[24] *Adaptive Annotation Using a Human-Robot Interface System PARTNER.* IEEE, 2001. Yamashita et al.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin Siangchin whose telephone number is (703)305-7569. The examiner can normally be reached on 9:00am - 5:30pm, Monday - Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on (703)308-6604. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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